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[54] **APPARATUS AND METHOD FOR RECOGNIZING FACIAL EXPRESSIONS AND FACIAL GESTURES IN A SEQUENCE OF IMAGES**

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[58] **Field of Search** 382/118, 236, 382/294, 115, 107; 395/200.34; 348/402

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[57] **ABSTRACT**

A system tracks human head and facial features over time by analyzing a sequence of images. The system provides descriptions of motion of both head and facial features between two image frames. These descriptions of motion are further analyzed by the system to recognize facial movement and expression. The system analyzes motion between two images using parameterized models of image motion. Initially, a first image in a sequence of images is segmented into a face region and a plurality of facial feature regions. A planar model is used to recover motion parameters that estimate motion between the segmented face region in the first image and a second image in the sequence of images. The second image is warped or shifted back towards the first image using the estimated motion parameters of the planar model, in order to model the facial features relative to the first image. An affine model and an affine model with curvature are used to recover motion parameters that estimate the image motion between the segmented facial feature regions and the warped second image. The recovered motion parameters of the facial feature regions represent the relative motions of the facial features between the first image and the warped image. The face region in the second image is tracked using the recovered motion parameters of the face region. The facial feature regions in the second image are tracked using both the recovered motion parameters for the face region and the motion parameters for the facial feature regions. The parameters describing the motion of the face and facial features are filtered to derive mid-level predicates that define facial gestures occurring between the two images. These mid-level predicates are evaluated over time to determine facial expression and gestures occurring in the image sequence.

31 Claims, 18 Drawing Sheets